

Remarks/Arguments:

Claims 1, 5-7, and 11-16 are pending. Claims 2-4 and 8-10 are cancelled. Claims 1 and 7 are amended, and claims 17 and 18 are added. Support for the claim amendments and new claims can be found, for example, at page 7, lines 15-20, and page 18, lines 6-14 of the specification. No new matter has been added.

The invention is directed to an inverter device including a current sensor for detecting a current of one or more stator windings. In an exemplary embodiment, the inverter device is used in an air conditioning system. The current is detected in the stator windings in order to detect a rotational position of a magnetic rotor. Direct current voltage to the stator windings is switched by three phase modulation. Within one carrier period of the three phase modulation, a time is added to or subtracted from a current feeding period for each phase of the three stator windings.

Claims 1-4 stand rejected under 35 U.S.C. § 102(e) as anticipated by U.S. Patent Application Pub. No. 2004/0095090 to Nukushina. It is respectfully submitted, however, that the claims are patentable over the art of record for the reasons set forth below.

Nukushina is directed to a method of detecting motor current and a motor control device. As shown in Nukushina's FIG. 1, for example, the control device includes a current detecting resistor 4 and an electric motor 7. Nukushina further includes a current detector 9a which detects currents of three phases delivered to electric motor 7. This allows vector control of the electric motor. Shibuya is directed to a motor-driver compressor. As shown in FIG. 1, for example, motor-driven compressor 10 may include a motor 35. Motor 35 may be a brushless motor. Higashiyama is directed to an air conditioning system. As shown in FIG. 1, for example, the air conditioning unit 100 includes an inverter 22 which may receive refrigerant via a refrigerant pipe 15 from an evaporator 14.

Applicants' invention, as recited by claim 1, includes a feature which is neither disclosed nor suggested by the art of record, namely:

...wherein ... within a carrier period of the three-phase modulation, a current feeding time is equally added or subtracted in a current feeding period in each phase of the stator windings....

This means that the same current feeding time is added to or subtracted from a current feeding period in each of the three phases of the modulation within a carrier period. This feature is found in the originally filed application at page 7, lines 18-20, and page 22, lines 1-14. No new matter has been added.

As shown in FIG. 4C of Nukushina, for example, Nukushina discloses decreasing a current feeding time width of the U-phase and increasing a current feeding time width of V-phase. Further, as shown in FIGS. 5B & 5C of Nukushina, for example, Nukushina discloses decreasing a current feeding time width only of the V-phase. Shibuya discloses that the transistors of inverter 48 receive control signals from control circuit 47. Inverter 48 then converts DC current into a three-phase current suitable for operating motor 35. See Shibuya at column 5, lines 22-28. Higashiyama discloses that inverter 22 may comprise means for controlling 221 the rotation speed of compressor 11 or means for stopping 222 the rotation of compressor 11. See Higashiyama at column 4, lines 27-34.

The claimed invention is different from Nukushina because Nukushina fails to disclose or suggest decreasing or increasing a current feeding time width of each of the three phases during a carrier period. Nukushina discloses decreasing or increasing the current feeding time width of only one or two phases of the three phase period. This is different from the claimed invention because claim 1 recites that a current feeding time is equally added or subtracted to a current feeding period in each phase of the stator windings within a carrier period. Further, the claimed invention is different from Shibuya and Higashiyama because neither Shibuya nor Higashiyama disclose or suggest an inverter device adjusting the length of a current feeding period during the carrier period of three phase modulation.

It is because Applicants include the feature of "within a carrier period of the three-phase modulation, a current feeding time is equally added or subtracted in a current feeding period in each phase of the stator windings," that the following advantages are achieved. For example, adding or subtracting to the current feeding period for all three phases does not affect the phase voltage for the carrier period. The current feeding time may be added to each phase such that all three phases are turned on in the center of the carrier period. When all three phases are turned on, no current flows in the current sensor, and no power is supplied to the motor from the power source. This is the same as when all three phases are turned off at the end of the carrier period. This has the effect of dividing the carrier period into two halves, such that, as compared with two-phase modulation, the carrier period is halved and the carrier

frequency is doubled. This allows for the combination of noise and vibration reduction, associated with three phase modulation, with more accurate detection of the position of the magnetic rotor, associated with the increased carrier frequency. See Applicants' specification at page 21, line 3 to page 22, line 18, and FIG. 16.

Accordingly, for the reasons set forth above, claim 1 is patentable over the art of record.

The rejection of claims 2-4 is obviated by the cancellation of those claims.

Claims 5-12 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Nukushina in view of U.S. Patent No. 6,564,576 to Shibuya. Claims 5 and 6 are patentable by virtue of their dependency on allowable claim 1. Claim 7, while not identical to claim 1, includes features similar to the features discussed above with respect to claim 1. Accordingly, claim 7 is also patentable over the art of record for the reasons set forth above with regard to claim 1. The rejection of claims 8-10 is obviated by the cancellation of those claims. Claims 11 and 12 are patentable by virtue of their dependency on allowable claim 7.

Claims 13-16 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Shibuya in view of Nukushina and further in view of U.S. Patent No. 6,523,361 to Higashiyama. These claims, however, are patentable by virtue of their (indirect) dependency on allowable claim 7. Additionally, Applicants' invention, as recited by claims 15-16, includes a feature which is neither disclosed nor suggested by the art of record, namely:

...wherein the inverter device is disposed between the suction pipe and the compressor.

This means that an air conditioner includes a suction pipe for sucking coolant from a compressor. The inverter device is positioned between the suction pipe and the compressor in order to be cooled by the suction pipe.

As shown in FIG. 1 of Higashiyama, for example, Higashiyama discloses the inverter 22 disposed below the compressor 11. A refrigerant pipe 15 sucks refrigerant from compressor 11 to condenser 12. The claimed feature is different from the art of record because Higashiyama fails to disclose or suggest positioning the inverter 22 between the compressor 11 and the refrigerant pipe which sucks refrigerant from the compressor 11 to the condenser 12.

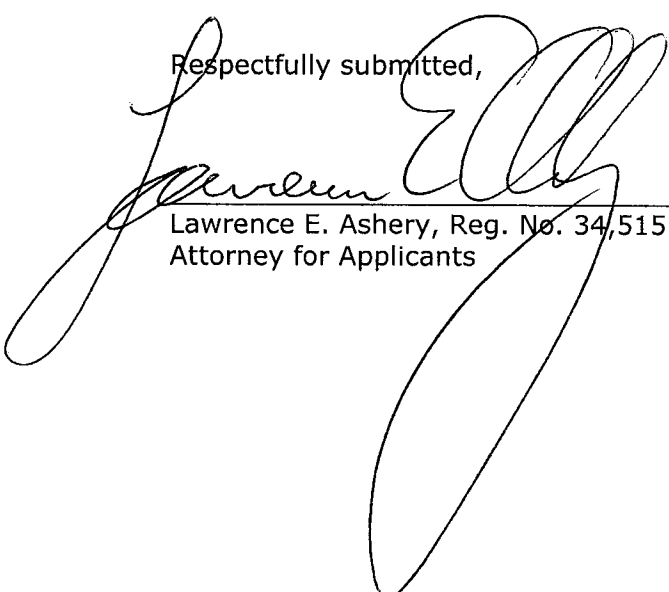
It is because Applicants include the feature of "the inverter device is disposed between the suction pipe and the compressor" that the following advantages are achieved. Because the inverter is positioned between the suction pipe and the compressor, the suction pipe is not heated by the compressor. This prevents the efficiency of the compressor from being lowered. See Applicants' specification at page 24, lines 2-19.

Accordingly, for the additional reasons set forth above, claims 15 and 16 are patentable over the art of record.

New claims 17-18, which include all of the limitations of claim 1, are submitted to patentably distinguish over the cited art for at least the same reasons as claim 1.

In view of the amendments and arguments set forth above, the above-identified application is in condition for allowance which action is respectfully requested.

Respectfully submitted,



Lawrence E. Ashery, Reg. No. 34,515
Attorney for Applicants

LEA/AJK/dmw

Dated: April 8, 2009

P.O. Box 980
Valley Forge, PA 19482
(610) 407-0700

405716